

WHAT IS CLAIMED IS:

1. 1. A multilayered torsional hinged resonant pivoting device comprising:
 2. a hinge layer defining a support structure and an attaching member, said support structure for pivotally supporting said mirror attaching member along a first axis of rotation by a pair of torsional hinges, said attaching member having a front side and a back side, and said attaching member defining spines extending in opposite directions and away from said first axis;
 6. a front layer having a front portion, a back portion and a selected thickness, said back portion of said front layer mounted to said front side of said attaching member and said front layer having a known mass moment about said first axis; and
 9. a back layer mounted on said back side of said attaching member and having a mass moment substantially equal to and opposite said known mass moment of said front layer, such that the center of mass of the combined front and back layers is substantially coplanar with the first axis of rotation and the moment of inertia of said multilayered torsional hinged device is substantially centered on said first axis of rotation.
1. 2. The multilayered device of claim 1 wherein said front portion of said front layer has a first size and shape and said back portion of said front layer further defines spines corresponding to said spines defined by said attaching member.
1. 3. The multilayered device of claim 2 wherein said back layer further defines spines corresponding to said spines defined by said attaching member.
1. 4. The multilayered device of claim 1 wherein said back layer further defines spines corresponding to said spines defined by said attaching member.

1 5. The multilayered device of claim 1 wherein said hinge layer comprises an anchor
2 member connected to said attaching member along said first axis by said first pair of torsional
3 hinges.

1 6. The multilayered device of claim 5 wherein said anchor member is a support frame.

1 7. The multilayered device of claim 5 wherein said anchor member is a pair of anchor pads.

1 8. The multilayered device of claim 1 wherein said support structure of said hinge layer
2 comprises a gimbals portion connected to said attaching member along said first axis by said pair
3 of torsional hinges and an anchor member pivotally supporting said gimbals portion by a second
4 pair of torsional hinges along a second axis substantially orthogonal to said first axis.

1 9. The multilayered device of claim 3 wherein said support structure of said hinge layer
2 comprises a gimbals portion connected to said attaching member along said first axis by said pair
3 of torsional hinges and an anchor member pivotally supporting said gimbals portion by a second
4 pair of torsional hinges along a second axis substantially orthogonal to said first axis.

1 10. The multilayered device of claim 8 wherein said anchor member is a support frame.

1 11. The multilayered device of claim 1 wherein said back layer is a permanent magnet.

1 12. The multilayered device of claim 2 wherein said back layer is a permanent magnet.

1 13. The multilayered device of claim 11 and further comprising a magnetic coil connected to
2 an alternating voltage having a frequency substantially equal to the resonant frequency of the
3 pivoting device and wherein said magnetic coil and said permanent magnet interact to create
4 pivotal movement of said device at said resonant frequency.

1 14. The multilayered device of claim 12 and further comprising a magnetic coil connected to
2 an alternating voltage having a frequency substantially equal to the resonant frequency of the
3 pivoting device and wherein said magnetic coil and said permanent magnet interact to create
4 pivotal movement of said device at said resonant frequency.

1 15. The multilayered device of claim 2 wherein said front portion of said front layer is a
2 reflective surface and said multilayered device is a scanning mirror.

1 16. The multilayered device of claim 15 wherein said back layer further defines spines
2 corresponding to said spines defined by said attaching member.

1 17. The multilayered device of claim 15 wherein said back layer is a permanent magnet.

1 18. The multilayered device of claim 17 wherein said support structure of said hinge layer
2 comprises a gimbals portion connected to said attaching member along said first axis by said pair
3 of torsional hinges and an anchor member pivotally supporting said gimbals portion by a second
4 pair of torsional hinges along a second axis substantially orthogonal to said first axis.

1 19. The multilayered device of claim 18 and further comprising a magnetic coil connected to
2 an alternating voltage having a frequency equal to a selected sweep frequency of said scanning
3 mirror and wherein said magnetic coil and said permanent magnet interact to create pivotal
4 oscillations of said scanning mirror at said selected sweep frequency.

1 20. The multilayered device of claim 19 wherein said selected sweep frequency is
2 substantially equal to the resonant pivoting frequency.

1 21. The multilayered device of claim 17 and further comprising a magnetic coil connected to
2 an alternating voltage having a frequency equal to a selected sweep frequency of said scanning
3 mirror and wherein said magnetic coil and said permanent magnet interact to create pivotal
4 oscillations of said scanning mirror at said selected sweep frequency.

1 22. The multilayered device of claim 21 wherein said selected sweep frequency is
2 substantially equal, to the resonant pivoting frequency.

1 23. The multilayered device of claim 3 and further comprising piezoelectric material bonded
2 to said support structure of said hinge layer to create resonant pivoting of said mirror.

1 24. The multilayered device of claim 1 wherein said hinge layer is made from single crystal
2 silicon.

1 25. The multilayered device of claim 2 wherein said hinge layer is made from single crystal
2 silicon.

1 26. The multilayered device of claim 3 wherein said hinge layer is made from single crystal
2 silicon.

1 27. The multilayered device of claim 24 wherein said front layer is made from single crystal
2 silicon.

1 28. The multilayered device of claim 25 wherein said front layer is made from single crystal
2 silicon.

1 29. The multilayered device of claim 26 wherein said front layer is made from single crystal
2 silicon.

1 30. The multilayered device of claim 17 and further comprising a magnetic coil connected to
2 an alternating voltage having a frequency equal to a selected sweep frequency of said scanning
3 mirror and wherein said magnetic coil and said permanent magnet interact to create pivotal
4 oscillations of said scanning mirror at said selected sweep frequency.

1 31. The multilayered device of claim 30 wherein said selected sweep frequency is
2 substantially equal to the resonant pivoting frequency.